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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Brian Ruby

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EXAMINER

MILLER, JR, JOSEPH ALBERT

ART UNIT

PAPER NUMBER

1715

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/578,550	<b>Applicant(s)</b> RUBY, BRIAN	
	<b>Examiner</b> JOSEPH MILLER JR	<b>Art Unit</b> 1715	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 28 January 2010.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 74-94 is/are pending in the application.
- 4a) Of the above claim(s) 88-93 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 74-87 and 94 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |                                                                                     |                                                                   |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                    | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)         | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____                                                         | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Claim Rejections - 35 USC § 102***

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 74, 75, 79 and 80 are rejected under 35 U.S.C. 102(b) as anticipated by Dai (6,401,526).

Dai teaches the formation of a substrate with multiple tips (support structures) for the growth of nanotubes (Fig. 2A) and the catalyst coating of the tips (Fig. 2B) (col 6, lines 10-33), thereby teaching the coating step of instant claim; it is clear that the tips having a base and apex. Nanotubes are then grown on the tips (Fig. 2D).

Dai further teaches the shortening of the nanotubes to a predetermined length (col 7, lines 22-53), performed by positioning a second substrate against the nanotube tips. The second substrate is positioned distal to the multiple tips; because the substrate is positioned at the tips, the distance correlates with the maximum predetermined length of the nanotubes.

The nanotubes are “formed”, i.e. shortened by applying a voltage between the second substrate and the base substrate of the SWNTs. Based on Fig. 2D, the original tips are still present at the shortening (i.e. forming) phase.

Regarding claim 75, Dai teaches the formation of carbon nanotubes.

Regarding claim 79, the second substrate is a heavily doped (i.e. conductive) silicon substrate (col 7, lines 44-48).

Regarding claim 80, Dai teaches the use of voltage to shorten carbon nanotips.

***Claim Rejections - 35 USC § 103***

Claims 76 and 77 are rejected under 35 U.S.C. 103(a) as unpatentable over Dai (6,401,526) as applied to claim 74 above.

The teachings of Dai are described above.

Dai teaches the disposition of the catalyst material on the tips whereon nanotubes will be formed (col 6, lines 10-33). Dai specifically teaches an embodiment where the tips are attached to a "towered" so that the catalyst coating will be on the 'sides' of the tips (col 6, lines 34-44). The 'sides' as indicated by Dai are not limited and it would be obvious to coat the apex and/or the base of the tips, either in the embodiment depicted in Figs 2 or Fig. 3.

While the depiction in Figures 2A-D *appears* to show coating of the catalyst between the apex and the base, Dai is not limited to the embodiment depicted in the Figures. The third embodiment is intended in fact only to avoid catalyst material from depositing on the substrate between the support structures.

Claims 74-77, 80, 85 and 86 are rejected under 35 U.S.C. 103(a) as unpatentable over Lee (2002/0046953) in view of Dai (6,401,526).

Lee teaches a method of catalyst induced nanotube growth (abstract). Lee teaches the formation of a substrate 57 (**or** 53) (Fig. 6, [0055], [0063]) including a plurality of nanotube growth catalysts placed opposite to a second substrate (55, Fig. 6).

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The carbon nanotubes are then grown by flowing a carbonaceous gas in the chamber area (i.e. between the two substrates). Though not specifically stated, the growth of the nanotubes would clearly be limited by the distance between the substrates 53/57 and 55. Lee teaches the control of the length of the nanotubes via control of the CVD process duration [0070]. It would have been obvious to someone of ordinary skill in the art at the time of the invention to limit the duration accordingly with the distance between the substrates as this would minimize chamber space, potentially reducing the amount of gas (and energy) needed to effect growth of the nanotubes. One would not desire the chamber to be larger than the maximum size of nanotips to be produced.

While Lee teaches the use of a substrate with multiple tips for the formation of carbon nanotubes, he teaches deposition of catalyst material on individual tips and does not explicitly teach the formation of a catalyst layer on a substrate with multiple tips.

Dai teaches the formation of a substrate with multiple tips (support structures) for the growth of nanotubes (Fig. 2A) and the catalyst coating of the tips (Fig. 2B) (col 6, lines 10-33), thereby teaching the coating step of instant claim; it is clear that the tips having a base and apex. Nanotubes are then grown on the tips (Fig. 2D).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the method of coating multiple tips for nanotube growth via the method of Dai to the nanotube formation process of Lee because it would allow one not only to grow multiple nanotubes at one time but form the 'precursor' tips at one time, thereby saving process time. It is clear that "mass production" is important to Lee both in statement [0052] and the growth of multiple nanotubes simultaneously. Each teaches

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the formation of tips for AFMs (abstracts), therefore one would expect the quality of the formed nanotubes to be comparable/applicable.

Regarding claim 75, Lee teaches carbon nanotubes (abstract).

Regarding claims 76 and 77, Dai teaches the disposition of the catalyst material on the tips whereon nanotubes will be formed (col 6, lines 10-33). Dai specifically teaches an embodiment where the tips are attached to a “towered” so that the catalyst coating will be on the ‘sides’ of the tips (col 6, lines 34-44). The ‘sides’ as indicated by Dai are not limited and it would be obvious to coat the apex and/or the base of the tips, either in the embodiment depicted in Figs 2 or Fig. 3.

Regarding claim 79, it would be obvious to apply the use of a conductive second substrate, as Lee teaches it as an “anode”.

Regarding claim 80, Dai teaches the shortening of the nanotubes to a predetermined length (col 7, lines 22-53), performed by positioning a second substrate against the nanotube tips by applying a voltage across the two substrates. It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the method taught by Dai to shorten nanotubes formed by the method of Lee in view of Dai as one could effectively shorten the nanotubes to desired length based on Dai’s success in shortening nanotubes.

Regarding claim 85, Lee teaches the use of a vacuum chamber [0064] at a temperature of 700 degree or 900-1000 degrees Celsius in some embodiments [0067-8] using gases such as methane, nitrogen and hydrogen [0071].

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Regarding claim 86, Lee is silent on the time of flowing of gases, however, it would be a matter of standard process optimization to determine the amount of time required to form nanotubes of the desired length, based on the total process conditions used, including but not limited to gas flows, pressure, and temperature.

Claims 78, 81, 82, 87 and 94 are rejected under 35 U.S.C. 103(a) as unpatentable over Lee (2002/0046953) in view of Dai (6,401,526) as applied to claims 74 and 85, respectively above and in further view of Lieber (2002/0122766).

The teachings of Lee in view of Dai are described above. Lee teaches formation of carbon nanotubes via a CVD process but does not specifically teach flushing the area with a nonreactive gas or cleaving a nanotube from a substrate using voltage.

Lieber teaches the formation of carbon nanotubes via CVD (abstract).

Regarding claims 78 and 87, Lieber teaches the use of argon gas during the furnace heat up and cool down periods (examples 5 and 7, [0099, 0103]). It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of an inert and/or nonreactive gas into the chamber during heat up and cool down periods as flowing such a gas into the chamber would allow the chamber to come to the appropriate temperature with a gas present but allow for a controlled reaction by avoiding the presence of a reactive gases (i.e. if the reactive gases were applied during cool down, nanotube formation may continue, but in a less controlled manner than during a stable temperature process). The introduced gases are obviously and/or inherently flushed through the chamber.

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Regarding claims 81, 82 and 94, Lieber teaches that applying voltage between two substrates may be used to cleave the nanotube/tip from the substrate [0079]. It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of the voltage to cleave a nanotube from a substrate as taught by Lieber to the method of Dai as one could apply an appropriate voltage as taught by Lieber to the method of Dai and have a reasonable expectation of cleaving a nanotube based on Lieber's success in doing so. Lieber teaches the use of voltage in the range of 10-25V thereby reading on instant claimed range.

Claims 83 and 84 are rejected under 35 U.S.C. 103(a) as unpatentable over Lee (2002/0046953) in view of Dai (6,401,526) as applied to claim 74 above and in further view of Mancevski (6,597,090).

The teachings of Lee in view of Dai are described above. Lee teaches formation of carbon nanotubes via a CVD process but does not specifically teach cleaving and shortening the nanotubes using liquid or gas phase chemicals.

Mancevski teaches a process for forming carbon nanotubes via CVD (col 10, lines 1-40). Mancevski teaches that wet or dry etching may be used to uncover carbon nanotubes from a matrix/substrate material (col 10, lines 41-46). The etching is used to control the length of the nanotube as well as to remove it from the substrate (col 11, lines 6-21).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of wet or dry etching (liquid phase, claim 83 or gas phase,



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claim 84) as taught by Mancevski to the carbon nanotube formation method of Lee as one could apply wet or dry etching with a reasonable expectation of removing carbon nanotubes from a substrate based on Mancevski's successful use of the methods. In each teaching the resulting nanotubes may be used as AFM tips (Mancevski, col 11, lines 18-21) based on similarities in substrates.

### ***Response to Arguments***

Examiner has withdrawn 112 rejection and objections to the specification based on applicant's confirmation of inclusion of the material in the originally filed PCT.

Applicant's arguments filed 01/28/2010 have been fully considered but they are not persuasive.

Regarding the 102 rejection over Dai, applicants state that Dai teaches CVD methods of growing nanotubes in two sections of the publication and then teaches shortening them in a third section. Applicants suggest that the section regarding the shortening is distinct from that regarding the CVD - while it may be true that they are distinct sections within the written specification, examiner's position is that Dai is referring to nanotubes produced by the methods described and therefore the rejection is appropriate. Dai is not required to explicitly write that the nanotubes are formed by the CVD method previously described just because the specification is broken down into distinct parts to highlight the specific aspects of the complete method.

Applicants further argue (pg 9, "Citing..." paragraph) that claim 74 requires nanotube growth without any shortening stage. First, there is no exclusion of a

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shortening stage being used in conjunction with instant claim. Further with specific respect to applicants arguments as to why the shortening of Dai would not apply, the nanotubes that are between the two substrates of Dai are "formed". Instant claim, as written, does not require growth. The nanotubes of Dai are formed as in shortened – the process occurs between the two substrates. The claimed process is not limited to a process where the nanotubes are *grown* between the two substrates.

Applicants also argue that an additional step according to claim 80 at least makes claim 74 clear in the context intended. Claim 74 is examined based on the language and limitations of claim 74, a dependent claim may further limit but such additional limitations are read into the dependent claim and not the independent claim. If such interpretation is desired in the independent claim (i.e. 74), then the language may be amended – the existence of a dependent claim does not necessitate a narrower view of the independent claim except in the examination of the dependent claim. Claim 80 is also rejected under Dai and is not limited to an interpretation wherein it is an “additional” step *unique* from the other steps of claim 74. Claim 80 may appropriately be interpreted as a step co-incidental to any other part of claim 74 or as an additional step not already included in claim 74.

Applicant makes further arguments related to the support in the specification for a process concerning the growth and not the shortening of nanotubes, however, claim language is not limited as such. Applicant’s specifically state that the claim language is used that “concern nanotube growth” (p10, first full paragraph) – examiner agrees

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however the language doesn't *require* nanotube growth and therefore claims are not limited as such.

Regarding the 103 rejection over Lee, examiner has taken a position that the substrate may be considered 57 or 53 in the noted Figure. Examiner takes the position that because 57 and/or 53 are a basis for the growth of nanostructures they are in fact substrates. Applicants argue that the substrates do not compare to the claimed substrates but offer no specific reasoning.

Applicants further argue about the dimensions of Lee's chamber stating that the chamber is understood by one of ordinary skill in the art to be on the order of centimeters. Examiner does not agree. It is agreed that the dimensions of the chamber are not stated by Lee, however, the figures suggest that the chamber is of the scale of the nanostructure depicted (35 in Fig. 6b). Even if the Figure are not be drawn to scale, Fig. 6b makes obvious a chamber size along the same order as the nanostructure size. Examiners position that the growth would be limited by the spacing between 53 and 55 is maintained. The growth does not have to be the width of the opposing substrates side to meet instant limitations. Instant claims only require a *correlation* between the growing width and the nanostructure length. Lee does not teach flowing CVD gases to continue forming nanotubes after the nanotubes have reached the other substrate (in text or figure), therefore this minimally constitutes a correlation as required by instant claims. Further, examiner provided the motivation that one would want to minimize the chamber space and reduce expenses by operating the chamber such that the distance

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is in line with the desired nanotube length (though again, claim never requires the growth length to equal the distance).

Dependent claims are argued on the basis of the rejections noted above and will therefore not be further addressed.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSEPH MILLER JR whose telephone number is (571)270-5825. The examiner can normally be reached on Mon-Thurs, 7am-4pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSEPH MILLER JR/  
Examiner, Art Unit 1715

/Timothy H Meeks/  
Supervisory Patent Examiner, Art Unit 1715